Camera/Video Control

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Circuit/Mechanical Descriptions

CCD Camera

A CCD Camera produces a video signal from the X-ray image received by the image intensifier and optics assembly. The CCD (Charge Coupled Device) is an analog IC that uses an array of photosensitive elements to convert incident illumination into a proportional electrical charge. Each photo element in the array stores an electrical charge and the charges are then shifted sequentially to an output gate. The output signal is an analog representation of the detected X-ray image. The analog data output from the CCD is then combined via transistor switching with a composite video signal.

60 Hz and 50 Hz CCD Cameras are provided on domestic and international systems, respectively.

Camera Communications

The Table/Generator Interface (TGI) Node CPU communicates to the Camera via Manchester encoded unidirectional differential serial communication (CAM_COMM+, CAM_COMM-). Camera communication consists of gain level, integrate, mode and check sum data.

Camera Iris Control

The TGI Node CPU and software drive the Camera Iris motor using Pulse Width Modulated (PWM) differential motor driver circuitry (CAM_IRIS_MOT+, CAM_IRIS_MOT-).

CAM_POTS_REF+ and CAM_POTS_REF- provide reference voltage to the camera iris potentiometer. CAM_IRIS_POSN is an analog signal that informs the TGI Node CPU where the Camera Iris is positioned with respect to the reference points.

Auto Brightness Stabilization

The Auto Brightness Stabilization (ABS) system automatically adjusts kVp, mA, and Camera Gain for an optimal image by comparing the video level from the camera to a reference level contained in the video level index. The functions adjusted are dependent on the Fluoro mode selected. Refer to the *X-ray & ABS* section in this manual and the *OEC Workstation Service Manual* for more information.

Thermal Electric Cooler

PS1 supplies +12 VDC to a current limiting resistor network located on the Power Distribution PCB. The TGI Node CPU applies +12 VDC to the camera cooler control signal (COOLER_CTL) and transistor Q1 turns on allowing current to flow through the resistor network, Q1 and the camera cooler signal CAM_COOLER_PWR to the Camera's Thermal Electric Cooler (TEC). The TGI Node CPU pulses this line according to a software algorithm – turning the TEC on and off.

The TGI Node CPU senses a voltage drop of 4-5 VDC when the TEC is on via the cooler sense signal (COOLER_SNS) and 0 VDC when the TEC is off. TEC operation can be checked at the TEC: CAM_COOLER_PWR (P1-3) and CAM_COOLER_RTN (P1-1). The voltage should read approximately 4.5 VDC when the TEC is turned on. The TEC will cycle according to an algorithm for the first 40 minutes the system is turned on and then it is on all the time.

Video Path

CCD Differential Analog Video

The differential analog video (VIDEO_HI, VIDEO_LO) and pilot tone (PILOT_HI, PILOT_LO) signal exit the CCD Camera Assembly at BNC Connector P2. The video enters the Video Conditioner PCB at P3. The Pilot Tone enters the Video Conditioner PCB at P2. The Video Conditioner compensates the video and pilot tone signals for losses when extension cables are used. Jumpers E1 and E2 are set depending on whether cable extensions are used (see Fault Isolation this section for jumper settings). The video circuitry is comprised of two high speed, low noise, high bandwidth voltage feedback amplifiers.

The video and pilot tone signals exit the Video Conditioner PCB at P4 and exit the camera housing at P6 and P7 respectively. The video is then routed thru a cable to a bulkhead on the Electronics Box located on the rear of the Uroview Tower. At the Tower bulkhead, the cable connects to the Workstation interconnect cable. Camera Video is then routed thru the Interconnect cable to the Workstation.

Note: The Workstation electronics digitize the analog video signal. The digitized video is then processed: anti-vignetting, gamma correction, pixel correction, etc., and the processed video is then reconverted to analog and displayed on the Workstation Monitor. Refer to the Workstation Service Manual *for more information.*

OEC Hi-Res Video

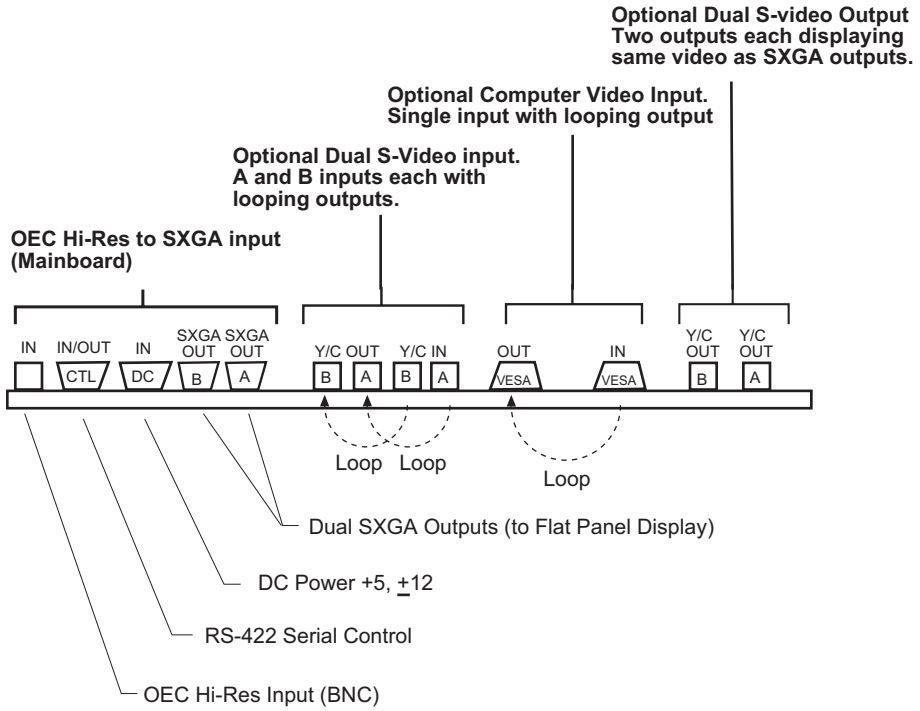
The processed analog video (HI_RES_VIDEO) exits the Workstation and travels back through the Interconnect Cable to the bulkhead on the Table's Electronics Box. The video is then routed to the Video Standards Converter (VSC) at BNC connector J1.

SXGA Video

The Video Standards Converter (VSC) converts the analog Hi-Res video (980 x 980) into standard SXGA analog video format (1280 x 1024) for viewing on the Flat Panel Display. The VSC can also convert other optional video inputs into standard SXGA. Other optional inputs are:

- S-Video
- Computer Video (SVGA, XGA and SXGA)

All inputs are converted to SXGA for display on the Uroview Tower's Flat Panel Display. Two Flat Panel Displays may be connected to the VSC. The VSC may have an optional S-Video output that converts the selected source video to S-video.



Video Standards Converter I/O

Video Controls

PIP Control

Pressing the Picture-in-picture (PIP) control opens and closes a window which allows the operator to view two video sources simultaneously.

When the PIP button is pressed on the X-ray Control Console (XCC) the key press is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the information on the data bus and the XCC CPU sends the information to the TGI PCB via ARCNet communication. The TGI puts the information on the data bus and the TGI CPU processes it and communicates the command to initiate PIP to the VSC via either RS-422 or RS-232 communication. The type of serial communication selected is dependant on the distance from the TGI to the VSC.

If the PIP switch is pressed on the X-ray Footswitch, the key press is communicated to the TGI PCB via signal PIP_ON. The TGI PCB puts the switch press on the data bus and the TGI Node CPU processes it and communicates the command to initiate PIP to the VSC via either RS-422 or RS-232 communication.

Video Shift Control

Pressing the Video Shift control will toggle through all the available video sources, unless the PIP window is enabled. If the PIP window is enable, pressing the Video Shift control switches the full screen image and the PIP window. The PIP window must be closed to shift through the available video sources.

When the Video Shift button is pressed on the X-ray Control Console the key press is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the information on the data bus and the XCC Node CPU sends the information to the TGI via ARCNet communication. The TGI puts the information on the data bus and the TGI Node CPU processes it and communicates the command to initiate PIP to the VSC via either RS-422 or RS-232 communication. The type of serial communication selected is dependant on the distance from the TGI to the VSC.

If the Video Shift switch is pressed on the X-ray Footswitch, the key press is communicated to the TGI PCB via signal PIP_SWAP. The TGI PCB puts the switch press on the data bus and the TGI Node CPU processes it and communicates the command to initiate Video Shift to the VSC via either RS-422 or RS-232 communication.

Image Orientation (Invert/Reverse) Controls

Two Image Orientation controls, located on the X-ray Control Console (XCC), Reverse and Invert the image on the left Workstation monitor. Pressing the Image Reverse control flips the image from left to right. Pressing the Image Invert control flips the image from top to bottom.

When either Image Orientation control is pressed on the XCC the key press is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the information on the data bus and the XCC Node CPU sends the command to the Workstation via ARCNet communication. The Workstation Image Processor then reverses or inverts the image.

Remote Workstation Controls

Save

Pressing the Save control, located on the XCC, saves the current image displayed on the left monitor to the Workstation hard-drive.

When the Save button is pressed the command is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the command on the data bus and the XCC Node CPU sends the command to the Workstation via ARCNet communication.

Swap

Pressing the Swap control, located on the X-ray Control Console, during live X-ray generation copies the left monitor image to the right monitor. Pressing the Swap control during Last Image Hold, swaps the images on the left and right monitors.

When the Swap button is pressed, the command is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the command on the data bus and the XCC Node CPU sends the command to the Workstation via ARCNet communication.

Mode

Pressing the Mode control, located on the X-ray Control Console, toggles between standard fluoroscopy and vascular imaging modes.

When the Mode control is pressed on the XCC the key press is communicated from the switch matrix to the XCC Interface PCB. The XCC Interface PCB places the command on the data bus and the XCC Node CPU sends the command to the Workstation via ARCNet communication.

Fault Isolation

Functional Test	Failure	Possible Cause
Perform the Verify Workstation Video Test	No video present at the left monitor	Check: • CCD Camera video output • Video Conditioner connection and video output • Workstation's Rear Panel (Left Hi-Res BNC output) • Power Supply voltages to Camera (see *Power Distribution Section*)
	Degraded image quality at the Workstation monitor.	Check E1 and E2 jumper settings on Video Conditioner PCB (see *Adjustments*, this section) that are related to cable length. Check output of Video and Pilot Tone at the Video Conditioner PCB. Op Amp failure possible. VIDEO_HI_OUT = TP7 VIDEO_LO_OUT = TP6 PILOT_HI_OUT = TP5 PILOT_LO_OUT = TP4 Check CCD Thermal Electric Cooler (see *Circuit Description*)
Perform the Image Resolution Test	Image resolution is not within specifications (see Image Resolution test specs in this section)	Check the: • Camera Lens focus adjustment (this section) • Image tube focus • CCD Thermal Electric Cooler (see *Circuit Description*)

Functional Test	Failure	Possible Cause
Perform Auto Technique Tracking Test contained in the *X-ray Generation Section* of this manual.	kVp is not within specified range. ABS may drive the kVp high or low if the Camera Video Level, Gain or Iris are malfunctioning.	Check the: • Video Level at the Workstation • Input dose • Camera alignment • Communication to Camera
Perform the Flat Panel Display Video Shift and PIP Test	Video source fails to shift and/or PIP fails	Check both Video Shift and/or PIP switches. (Switches located on X-ray Control Console and X-ray Footswitch). Check other controls located on the X-ray Control Console to verify ARCNet communication. Check RS-422/RS-232 communication to VSC.
Perform Image Orientation Test	Images fail to reverse and invert	Check the communication path between the X-ray Control Console and the Workstation. • Switch Matrix • ARCNet (see *Communication Section*)
Perform Remote Workstation Functions Test	Remote operation of Save, Swap or Mode fails	Check all three functional controls. If all controls fail then verify failure at the Workstation. If no failure on Workstation check communication path between X-ray Control Console and Workstation • Switch Matrix • ARCNet (see *Communication Section*) Otherwise, troubleshoot Workstation

Functional Tests

Verify Workstation Video

WARNING: The following procedure generates X-rays. Take appropriate precautions.

1. Power on the system by pressing the Workstation on button.
2. Turn on the Collimator Lamp by pressing the Lamp key.
3. Place the Converging Resolution Tool on the table-top, in the X-ray field, at a 45 degree angle to the table.
4. Verify that Fluoro mode is selected, and make an exposure by pressing an X-ray switch.
5. Verify that the video image is displayed on the Workstation's left monitor.

Image Resolution

1. Perform the *Verify Workstation Video Test*.
2. Verify that the limiting image resolution is greater than the minimum line pair/millimeter specifications listed for the system's image intensifier size:

II Size	NORM 60/50 Hz	MAG1 60/50 Hz	MAG2 60/50 Hz
14-inch	≥ 2.0 LP/mm	≥ 2.1 LP/mm	≥ 2.4 LP/mm
16-inch	≥ 1.8 LP/mm	≥ 2.1 LP/mm	≥ 2.4 LP/mm

Flat Panel Display Video, Shift and PIP

The Video Scan Converter must have one optional video source to perform this test.

WARNING: The following procedure generates X-rays. Take appropriate precautions.

1. Either generate an X-ray to display on the Workstation's left monitor or access an archived image using the Workstation's Image Directory.
2. Verify that the image displayed on the left monitor is also displayed on the Flat Panel Display (FPD).
3. Set up the optional video source.

Note: A gray image will be displayed on the FPD if the selected video source is not present at the VSC.

4. Press the Video Shift button and verify that the optional source is now displayed on the Flat Panel Display.
5. Press the PIP button and verify that the currently selected video source is now visible as a background image and OEC Hi-Res is displayed in the PIP window.
6. Press Video Shift again and verify that the full screen image and PIP image swap places.
7. Press PIP again and verify that the PIP window closes and only the OEC Hi-Res is displayed.

Image Orientation

These remote Workstation controls are located on the X-ray Control Console (XCC).

WARNING: The following procedure generates X-rays. Take appropriate precautions.

1. Either generate an X-ray to display an image on the Workstation's left monitor or access an archived image using the Workstation's Image Directory.
2. Press the Image Reverse button and verify that the image flips from left to right.
3. Press the Image Invert button and verify that the image flips from top to bottom.

Remote Workstation Controls – Save, Swap and Mode

These remote Workstation controls are located on the X-ray Control Console (XCC).

WARNING: The following procedure generates X-rays. Take appropriate precautions.

1. Generate an X-ray to display an image on the Workstation's left monitor.
2. Press the Save button and verify that the image was saved on the Workstation's hard-drive by accessing the Image Directory on the Workstation.
3. Press the Swap button and verify that the left and right monitor image trade places.
4. Press the Mode button and verify that the touchscreen controls toggle between standard fluoroscopy mode and vascular imaging mode. This function may not be available on all systems.

Adjustment

Video Conditioner PCB – E1, E2 Jumpers

Jumper E1 and E2 are set according to the distance video must travel (cable length) between the CCD Camera output and Workstation.

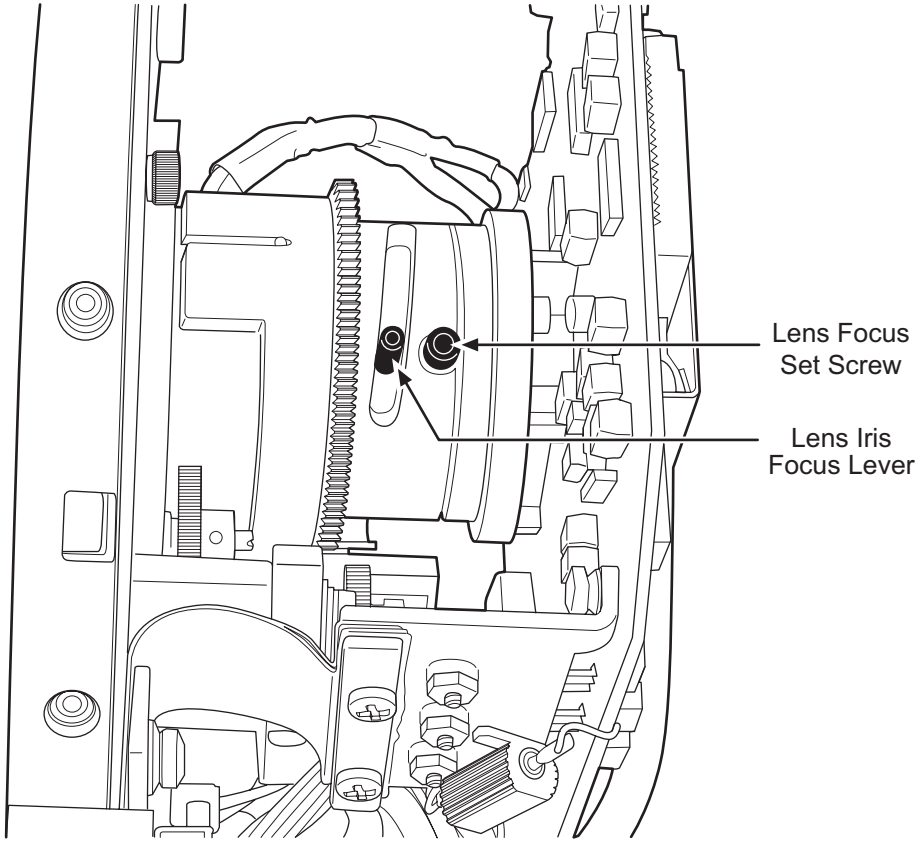
Cable Length	E1	E2
60 ft	1-2	1-2
40 ft	3-4	3-4
30 ft	5-6	5-6

Camera Lens Focus

WARNING: The following procedure generates X-rays. Take appropriate precautions.

1. Remove the Splash-n-Crash cover.
2. Remove the Camera EMI Shielding.
3. Place the Converging Resolution Tool on the table-top, in the X-ray field, at a 45 degree angle to the table.
4. Carefully, loosen the Lens Focus Set Screw.
5. Adjust the focus using the Lens Iris Focus Lever. (On some systems, you may have to slightly loosen the Lens Iris Focus Lever to get it to move).
6. Retighten the Lens Focus Set Screw (and Lens Iris Focus Lever).
7. Install the Camera EMI Shielding.

8. Install the Splash-n-Crash cover.



Camera Lens Focus Adjustment

Flat Panel Display

Proper adjustment of the Flat Panel Display (FPD) is necessary to achieve the best image quality. This adjustment procedure is necessary whenever an FPD is replaced and should be checked when maintenance is performed.

Brightness and Contrast

1. Using the Utility Suite, click on the Camera/Collimator Setup form and then display the grayscale test pattern on the left monitor.

Note: Monitor brightness and contrast adjustments affect each other. Therefore, alternating adjustments may be necessary. In general, observe the white steps while making brightness adjustments and observe black steps while making contrast adjustments.

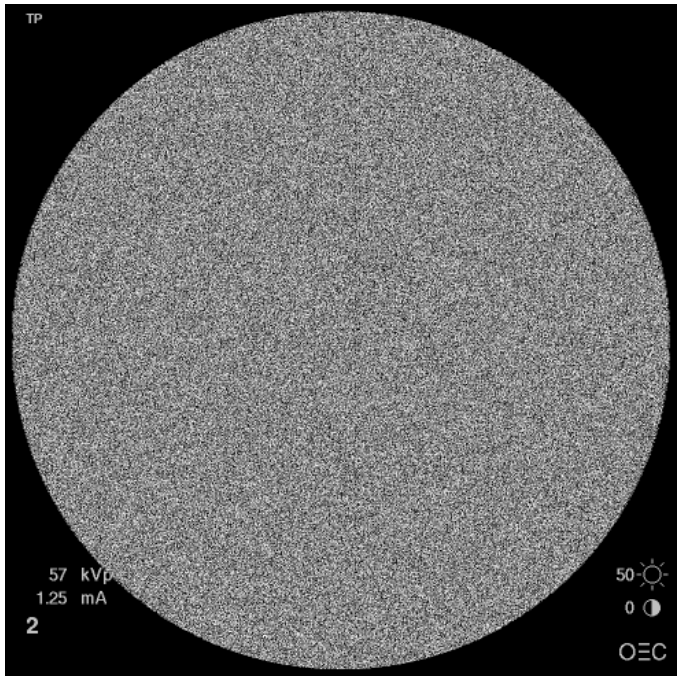
2. Press the Control button on the FPD and then press the Next button to locate the Brightness adjustment.
3. Using the + and – buttons, adjust the brightness.
4. Using the Control and Next FPD buttons, locate the Contrast adjustment.
5. Using the + and – buttons, adjust the contrast.
6. Verify that all 20 grayscale steps in the test pattern can be easily seen.

Positioning

1. Disconnect the OEC video input (J1 on the video standards converter). A dark gray rectangle will be displayed.
2. Using the Control and Next buttons on the FPD, locate the horizontal and vertical position adjustments (do not select auto brightness).
3. Using the + and – buttons ensure that the entire image is on the screen and centered.

Horizontal Sizing

1. Load and display the Random Pixel Image on the left monitor. The test pattern is available through the Utility Suite's *Collimator/Camera Setup* screen. The image on the display will be full screen without the circular blanking added.



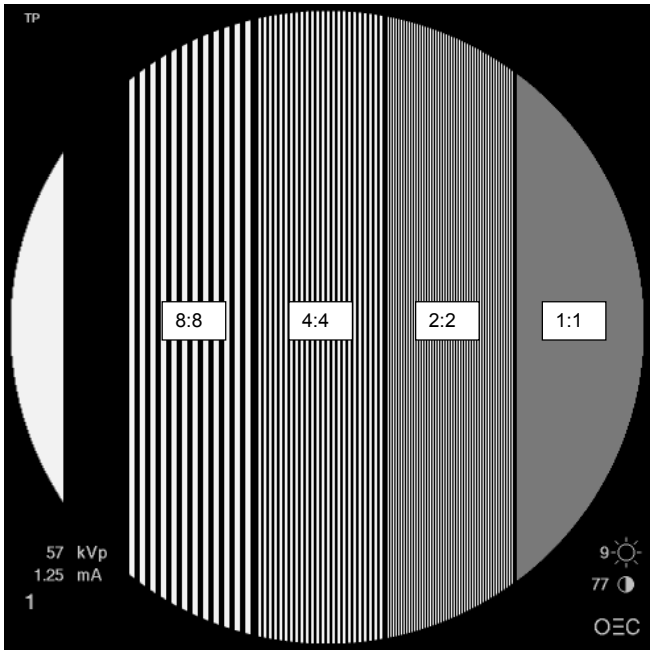
Random Pixel Image

2. Using the Control and Next buttons on the FPD, locate the horizontal sizing adjustment (third icon from the left on the menu).
3. Adjust the fine pixel clock adjustment to the center of its range.
4. Using the + and – buttons, adjust the horizontal sizing to eliminate all beat frequencies (vertical dark/bright bands) in the image. The + and – buttons are course adjustment, if necessary return to the fine pixel adjust and make fine adjustments.

Note: Beat frequencies appear as vertical bands. Typically, make a large horizontal size adjustment in either direction to ensure beat frequency banding is easily observed (many narrow bands). Make adjustments in the opposite direction while observing widening bands. Proper horizontal phasing is achieved when the banding gets as wide as the screen and the entire image is brightest. Normally, as the proper frequency is approached, a dark band (almost the width of the display) is observed. Pressing the horizontal size once more yields a bright image with no noticeable band. Pressing the horizontal size once more yields a single dark band again. It is the center (bright image without beat frequency band) adjustment that is desired. This completes coarse phase adjustment.

Phase Tuning

1. Load and display the OEC Multi-burst image on the left monitor. The test pattern is available through the Utility Suite's *Collimator/Camera Setup* screen.



OEC Multi-burst Image

2. Using the Control and Next buttons, locate the Fine adjustment.
3. Using the + and – buttons, minimize the noise while preserving high contrast in the highest frequency portion (1:1) of the pattern.

Note: The OEC Multi-burst Image consists of increasingly higher frequency stripes. From left to right, the image has a white vertical band, black vertical band, then 4 sections of increasing pixel on/off vertical stripes. Those burst sections are: 8 pixels on then off, 4 pixels on then off, 2 pixels on then off and 1 pixel on then off.

4. Verify that the stripes transition from full black to full white with no visible noise.

Resetting Color

1. Find the RGB setting and select the Native option
2. Saturation can be adjusted without affecting the grayscale.

Miscellaneous

Not applicable